Using Smartrek’s vacuum monitoring system

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Four main factors influence sap yields from maple trees. First is the root system itself. Healthy trees with adequate functional root systems, exposed to the sun’s fertile soil with adequate moisture, will grow fast and produce well. Second is weather conditions suitable for stimulating sap flow. Damaging snow and rain during this period can result in the destruction of the root system and tissue damage. Thirdly, excellent spot and tubing sanitation practices will result in lower microbial contamination of sap and lower flow rates. Thirdly, excellent spot and tubbing sanitation practices will result in lower microbial contamination of sap and lower flow rates. Finally, higher vacuum levels create a greater pressure gradient from the inside of the tree to the outside, producing higher flow rates from sap and increasing the efficiency of the entire process. All of these issues will have an effect on the overall yield of the sap.

Improved pumps, design, and layout of maple tubing systems, as well as improved tubbing, fittings, and spouts have led to higher and higher vacuum levels. However, maintaining such a high level of vacuum requires constant attention to maintain vacuum levels across a widely distributed network of tubing, and when a leak is detected, prompt action to locate and fix leaks. These activities, although necessary, require considerable time and effort.

At the University of Vermont Proctor Maple Research Center (PMRC), we have explored several different methods of both custom-built and commercially available vacuum monitoring over the past fifteen years. In general, however, it was not until quite recently that technological advances in sensors and wireless communications saw the commercial availability of robust and affordable wireless vacuum monitoring systems suitable for maple industry applications.

During the winter of 2013-2014, PMRC acquired the Smartrek Technologies monitoring system at both one way to monitor sap flow variables during the season for research and for our vacuum production activities. Initially our coverage was about 1/3 of our operation. In 2015 we expanded the system to have coverage of about 1/2 the sugarbushes. In 2016 we completed the build-out of the system to provide coverage for all our sugarbushes. Our present system includes over 72 vacuum/temperature sensors distributed across the two major sections of our sugarbushes, as well as 8 tank level sensors, and 10 pressure sensors. In each case, it was a very simple matter to expand the system by the addition of new nodes.

Although this article discusses our experience with the Smartrek system (now distributed by E2OC, Inc), there are several advantages of wireless vacuum monitoring systems available.

- We have not reviewed all of them, but encourage producers to explore their options. We selected the Smartrek system because it was one of the earliest wireless mesh-network systems developed, had a wide range of features available, and the company was very easy to communicate with and was open to suggestions for changes and the development of custom sensors for our research work. We have been extremely pleased with our choice.

The Smartrek system as currently configured includes a stationery “Gateway”, which connects the various nodes (sensors) together, and connects them to a central computer at the sugarbush. The Gateway is typically located at a central position within the base station for communications. A “Portable Gateway” is also available for use in the field when installing “Nodes”, troubleshooting sensors, or fixing leaks. While some users may wish to use a “Portable Gateway” in such fashions, in practice at PMRC, we rarely use it. This may be because our density of nodes is high and signal strength is typically not an issue. For users who wish to have a system where all nodes are remotely accessible, the “Portable Gateway” may have far more utility. The next element of the system is the Android-based Tablet or Smartphone running the Smartrek “Sugarchek” software (no iOS version is currently available). The tablet and software are primarily used to add, edit, or delete “Nodes” (sensors) and view their data on the “Graphics” view from the “Nodes” in the woods. “Nodes” are the individual sensors that measure the variable you are interested in, and communicate the information to the rest of the network. Together, a series of “Nodes” create a mesh-network of sensors which monitor.

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